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This reinforcement cage was used in the construction of a drilled shaft for the Chehalem Creek Bridge in Yamhill County. Courtesy of the Oregon Department of Transportation.

Cranes lifted precast concrete girders into place for the Chehalem Creek Bridge. Courtesy of the Oregon Department of Transportation.

Grade 80 steel reinforcement a success in Oregon project

By 2012, the Oregon Department of Transportation (ODOT) had conducted enough research on the benefits of ASTM A706 Grade 80 (550 MPa) steel reinforcement as an alternative to Grade 60 (410 MPa) steel reinforcement that it added guidelines for the use of the Grade 80 reinforcement to its *Bridge Design and Drafting Manual*. These guidelines were developed based on discussions with an Oregon reinforcing bar manufacturer, who confirmed both the availability and approximate cost premium for Grade 80 reinforcement.

ODOT has found the following benefits of Grade 80:

- The stress–strain curve for Grade 80 has a similar shape to that of Grade 60.
- Design with Grade 80 reinforcement uses the same processes and equations as Grade 60 reinforcement.
- Grade 80 has an additional 33% yield compared with Grade 60, with only a 10% to 12% additional material and fabrication cost.
- The reinforcing bar has good ductility and is weldable.
- The availability of Grade 80 reinforcement is improving due to its increased use in the building industry.

Currently, ODOT finds Grade 80 (550 MPa) reinforcement ideal for drilled shafts (both longitudinal and lateral reinforcement), bridge decks (especially if the design can be limited to a single bar size), and crossbeams (for main flexural steel with the same bar size top and bottom).

Its benefits were put to the test in 2016, with the building of the Chehalem Creek Bridge near Newberg, Ore., part of the Newberg-Dundee bypass project in Oregon. "The bridge is a 965 ft [294 m] long prestressed concrete girder bridge with a reinforced concrete deck," says Tanarat Potisuk, prestressed concrete standards engineer for ODOT. ODOT specified two different sizes of ASTM A706 Grade 80 (550 MPa) bars in drilled shafts.

Although the project has been a success, there were a couple of challenges along the way, Potisuk says. "There was a concern about possible confusion over the multiple rebar grades that were used in the construction project," he says.

Grade 80 (550 MPa) bars were only specified for the drilled shafts, while other grades were used elsewhere on the project. After talking with the construction inspector and contractor, though, there ended up being no issues in identifying the reinforcing bar because the bars were properly marked and tagged.

At first, availability was also a concern. "ODOT has been communicating with the steel rolling mills and including the minimum required quantity in the bridge design manual," he says. "As a result, the contractor had no problems acquiring Grade 80 [550 MPa] bars from the rebar fabricator."

According to Potisuk, the use of Grade 80 (550 MPa) reinforcing bar for this project was a success. "The higher strength of Grade 80 bars resulted in a smaller quantity of rebar and less congestion in the rebar cages," he says. "Therefore, a better quality of drilled shafts was obtained. With a smaller quantity and a similar unit price, the construction cost ended up being lower."

As a result, ODOT plans to specify Grade 80 (550 MPa) reinforcing bar for future projects when it is appropriate. —William Atkinson

Fast Fix 8 project features specialized reinforcement in Tennesee interstate

The construction manager/general contractor (CM/GC) project delivery method is being piloted in three Tennessee Department of Transportation (TDOT) projects. This method allows TDOT to engage a construction manager during the design process of a project to provide constructibility input through a competitive, qualification-based selection process. Following the design process, TDOT and the construction manager negotiate a guaranteed maximum price for the construction of the project based on the defined scope and schedule.

A project on Interstate 40, called the Fast Fix 8 project, was TDOT's first CM/GC project. Because it's a busy stretch of highway, time was valuable for the users and stakeholders. Using the CM/GC process, which shortens delivery time and reduces design errors, TDOT decided to close I-40 for 10 weekends and kept all lanes operational during the workweek.

Reinforcement was a critical element of the success of the project. The full-depth precast concrete deck panels were prestressed transversely for the bottom mat of reinforcement and contained nonprestressed reinforcing steel for the top-mat reinforcement.

"The department, in the development of the panel design, was looking at details and procedures to increase the durability of the full-depth deck panels," says Ted Kniazewycz, senior associate/engineer with Gresham, Smith & Partners in Nashville, Tenn., which worked with TDOT on the project. "The engineers proposed to utilize transverse prestressing strands in the bottom of the panels with enough force to keep the panels in compression under the design loads." In addition, epoxy-coated reinforcing steel was used in all other locations to inhibit future corrosion of the panel reinforcing steel.

For the main prestressing reinforcement in the bottom of the panels, ½ in. (13 mm) 270 kip (1860 MPA) prestressing strands were used at a nominal spacing of 9 in. (230 mm) center to center. "The strands were pulled to a force of 28,936 lb [128,710 N], which provided the desired compressive forces in the bottom of the panels," Kniazewycz says. Longitudinal

Workers place epoxy-coated steel reinforcing bars into a section of Interstate 40 for the Fast Fix 8 project in Tennessee. Courtesy of Gresham, Smith & Partners.

reinforcement in the bottom of the panels consisted of no. 3 (10M) bars at varying spaces that alternated on both sides of the strands.

For the main top transverse reinforcement, epoxy-coated no. 6 (19M) bars spaced at 8.5 in. (220 mm) were used, with closed-loop bars extending out the side where panel-to-panel joints were located over the prestressed concrete box beams.

"Straight bars extended from the side where the cantilevers or median was located," Kniazewycz says. The longitudinal reinforcement on the top was epoxy-coated no. 5 (16M) bars spaced at 12 in. (300 mm). These bars had lug-type details cast into the panels to allow for panel-to-panel connections with a 1 in. (25 mm) shear key between the panels and a splice bar placed between the panels.

"Careful attention was given to the spacing of the reinforcing so that there would not be conflicts where panel-to-panel connections would be made in the field," Kniazewycz says. "Additionally, the strands were allowed to project out of the panels 3 in. [75 mm] into the closure pours over the box beams." This helped with the panel connectivity for composite action for the superstructure section and afforded minimal conflict with the projecting shear stirrups from the box beams.

Kniazewycz says that the full-depth precast concrete deck panels had excellent field fit-up during the construction activities. The installed panels showed no distress on the bottom after installation and under full operational loading. "The closure pour material used at the panel-to-panel joints yielded excellent bonding characteristics to the panels, showing no signs of distress," Kniazewycz says. "The department is happy with the performance of the full-depth deck panels and will continue to utilize them on future bridge projects."
—William Atkinson